Nondestructive Evaluation Program

KSC Foundational Methodology for Additive Manufacturing - NDE of AM Titanium Alloys

Completed Technology Project (2015 - 2017)

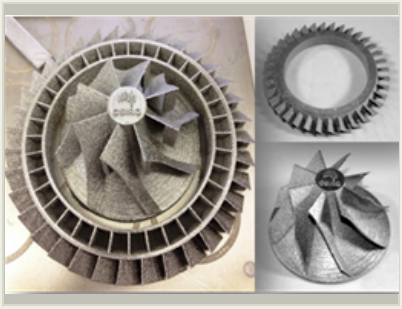
Project Introduction

Initially, in the first year of the project, the test specimens will be designed in CAD, or applicable design software, and be submitted to conditions where it will develop representative manufactured defects such as porosity and lack of fusion in a controlled and known manner. The test specimens will be manufactured by CSIRO using the Arcam Electron Beam Melting (Arcam EBM) manufacturing process and constructed from Titanium 6Al – 4V (Ti 6-4) powder. Identical test specimens without flaws may also be manufactured from the same process and used for a baseline comparison. Mid to late year one, NDE investigation will take place at Kennedy Space Center, FL utilizing the NASA KSC labs and onsite Engineering Services Contract. Computed Tomography (CT), Ultrasonic Testing (UT), and Laser UT will be used to identify and develop techniques to characterize the built in defects in each component. Engineering analysis will be performed to determine the most ideal NDE method.

Investigation will continue into the following years with the most appropriate NDE methods. New test components with more representative flaws may be required to expand the understanding of the NDE techniques capability to measure each type of flaw. The test results will show the ability of each NDE technique to detect and characterize each flaw as they relate to known critical flaw size requirements. This research will build a foundation of integrating NDE technology into the manufacturing process; therefore, being able to evaluate real time.

Anticipated Benefits

As additive manufacturing (AM) is being a desired method of creating parts in the space industry, a method of detection of internal flaws is highly benificial to asist in certifying AM parts for flight and for use in critical systems. It will be highly benificial to the manufacturing and qualification process to perform this inspection during (in-situ) the manufacturing process. This will cut down time, scrapped parts, and develop more efficient manufacturing process.



Impeller vanes printed using the EBM process. Credit: CSIRO

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Organizational Responsibility

Responsible Mission Directorate:

Office of Safety and Mission Assurance (OSMA)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Nondestructive Evaluation Program

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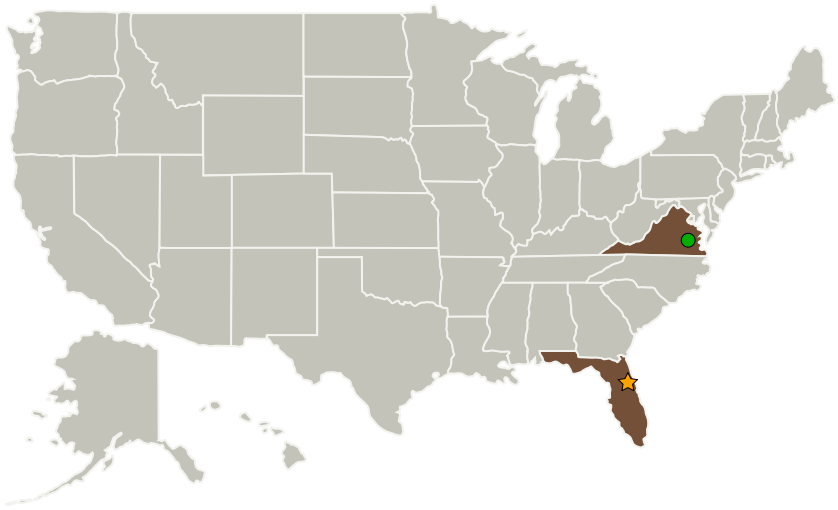
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Co-Funding Partners	Type	Location
Commonwealth Scientific and Industrial Research Organization(CSIRO)	Industry	Canberra, Outside the United States, Australia

Primary U.S. Work Locations	
Florida	Virginia

Project Management

Program Director:

Terrence W Wilcutt

Program Managers:

Jeannette F Plante
Jason P Moore
Eric R Burke

Project Manager:

Miles G Skow

Principal Investigator:

Bence B Bartha

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.5 Nondestructive Evaluation and Sensors

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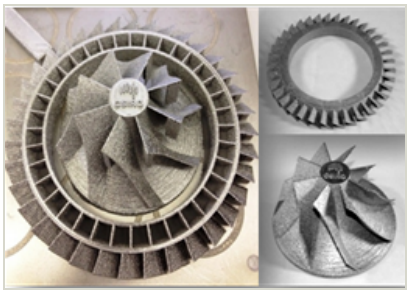
Images



Impeller Vanes
Impeller vanes printed using the EBM process. Credit: CSIRO
(https://techport.nasa.gov/image/20734)